

# High-Resolution Chandra Observations of the Crab Nebula in Coincidence with the April Gamma-Ray Flares

Allyn F. Tennant<sup>1</sup>, M. C. Weisskopf<sup>1</sup>, M. Tavani<sup>2</sup>, R. Buehler<sup>3</sup>, R. Blandford<sup>4</sup>,  
P. Caraveo<sup>2</sup>, E. Costa<sup>2</sup>, D. Horns<sup>5</sup>, C. Ferrigno<sup>6</sup>, S. Funk<sup>3</sup>, R. Mignani<sup>7</sup>, A.  
Lobonav<sup>8</sup>, A. de Luca<sup>9</sup>, Y. Uchiyama<sup>3</sup>

<sup>1</sup>NASA MSFC, <sup>2</sup>Ist di Astrofisica, INAF, Italy, <sup>3</sup>Stanford University,  
<sup>4</sup>Stanford university, <sup>5</sup>Universitat Hamburg, Germany, <sup>6</sup>Integral Science Data  
Center, Switzerland, <sup>7</sup>MSSL, United Kingdom, <sup>8</sup>Max-Planck Inst for Radio  
Astronomy, Germany, <sup>9</sup>Luca (Ist di Astrofisica, INAF, Italy).

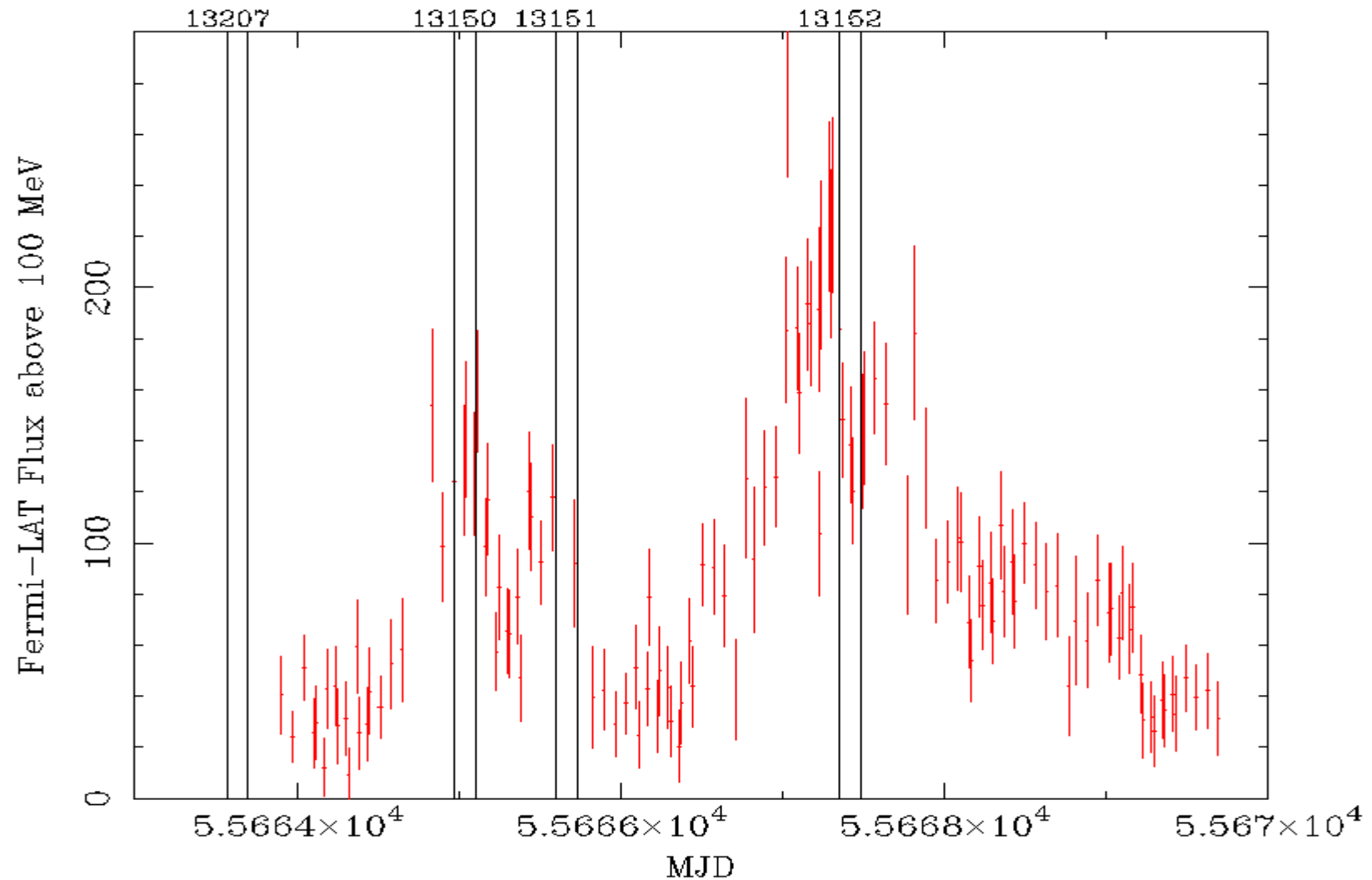
# The 2010 Sep flare

- Agile and Fermi both detected a flare from the Crab in Sep 2010
- Chandra executed a ToO
- Lots of minor changes in the nebular over the year
- But nothing obviously associated with the flare

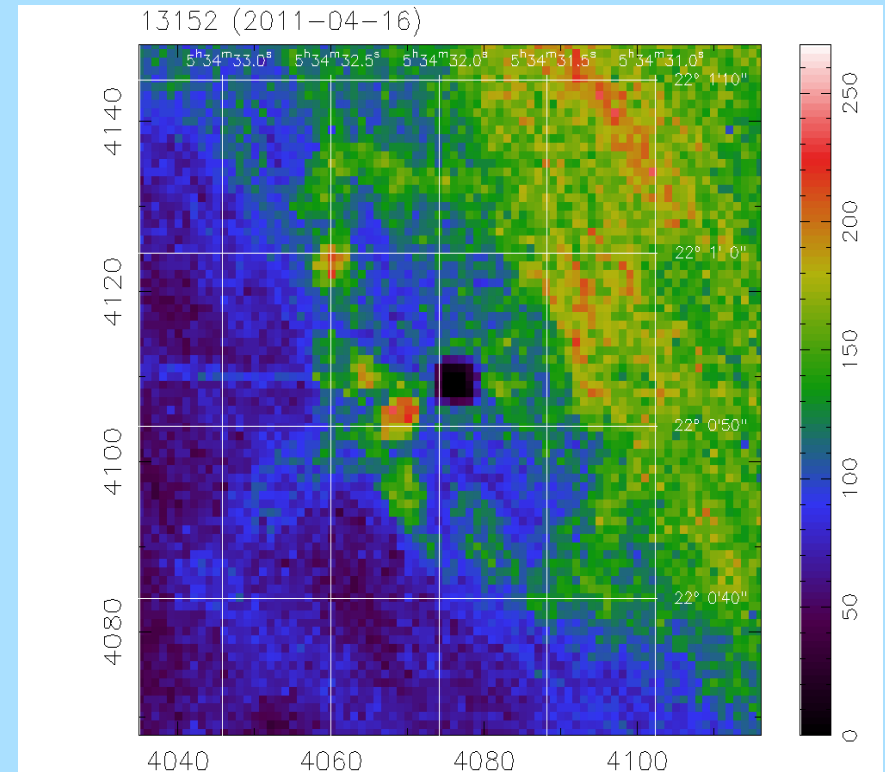
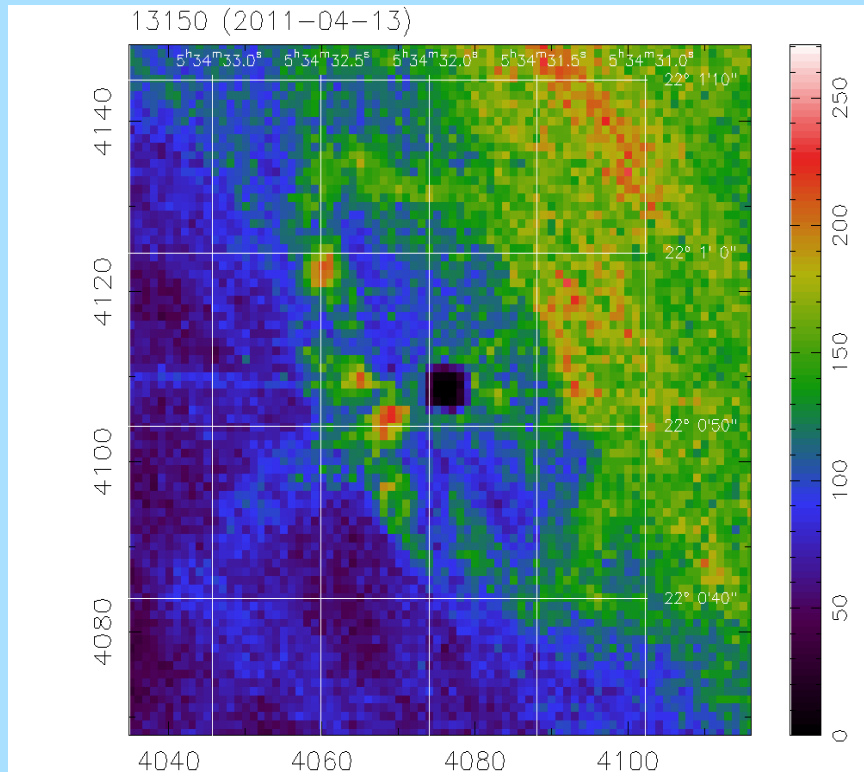
# Set up a monitoring program

- Two goals:
  1. Make sure we have a pre-flare observation
  2. Search for original of the recently discovered variations (10% in 2 years) reported by Wilson-Hodge (2011).
- 5 ksec observations once per month
- Future ToO, 10 ksec five observations in one month

# Gamma Ray flux high in April



# Nothing Obvious



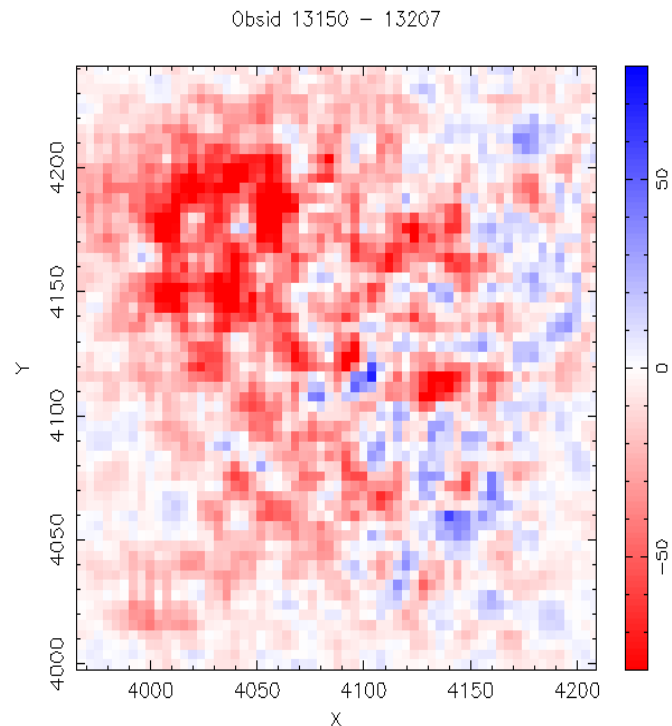
# What are we looking for?

- X-ray rise may slightly lead gamma ray increase.
  1. Acceleration typically reach X-ray energies first.
  2. Very few gamma ray photons, i.e., down scattering has minor impact on X-ray rate.
- However, synchrotron losses will cause gamma ray flux to decline first

# What are we looking for?

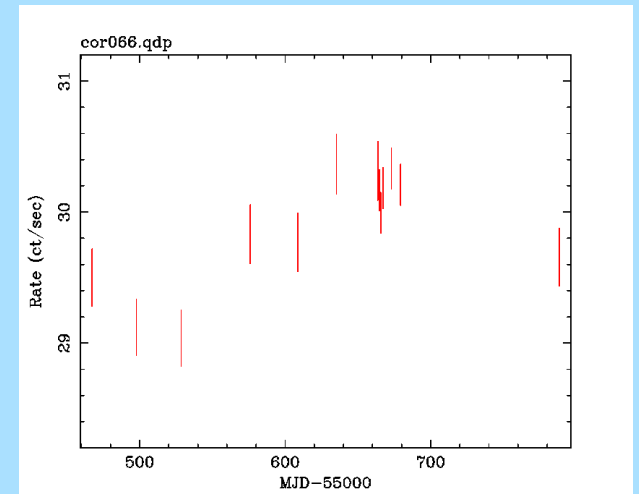
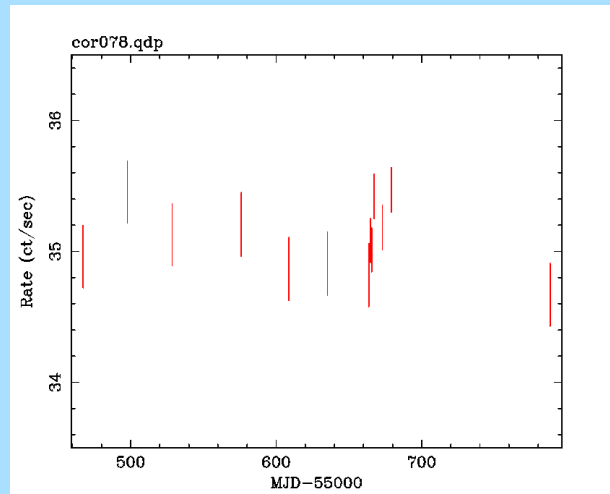
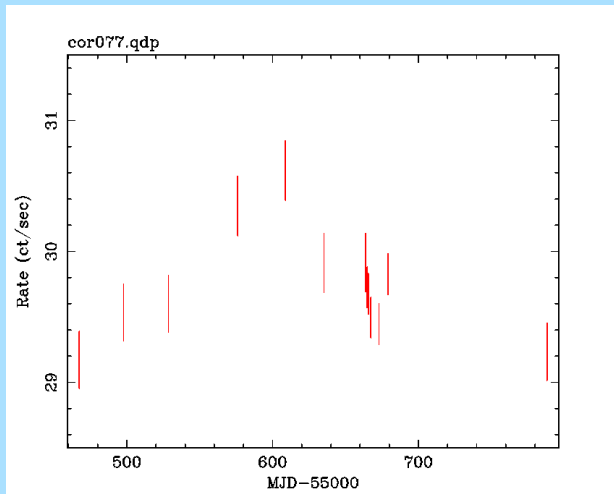
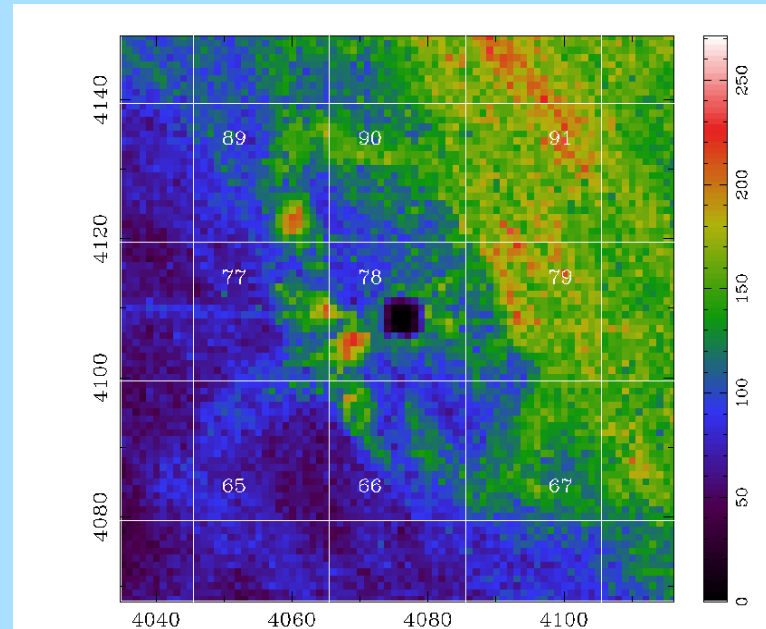
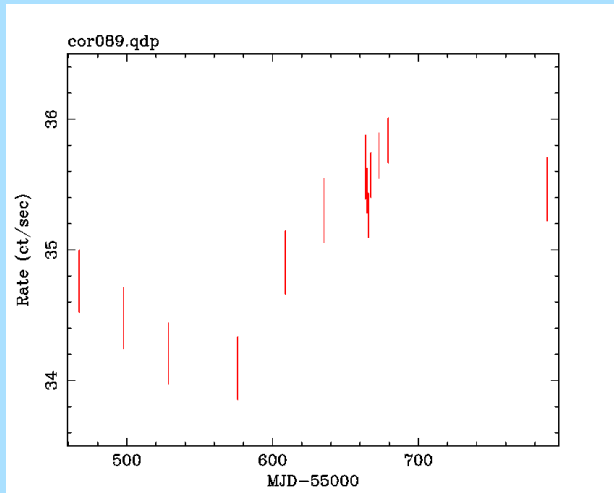
- Size should be single pixel
- Due to pileup, count rate could decline...
- Could see filaments colliding
- To prove that you are sensitive to variability you need to look at something that does not vary and show that it doesn't vary (R. Mushotzky).

# Search for variability



- Huge swath of nebular faded in 33 hours?
- No! Image closer to edge of detector and contamination layer thicker.
- Mostly corrected in cal.
- Complicated by pileup

# Light curves near pulsar



# Summary

- Monitoring observations continue
- Instrumental effects (slowly) being removed
- Still no obvious indication of gamma ray flare location